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COMMUNITY PROVISION FOR THE SERUM TREATMENT OF PNEUMOCOCCIC PNEUMONIAS*

I.

THE PROBLEM OF THE PNEUMONIAS

It is well known that in our part of the world "pneumonia" is not only a very prevalent but a very deadly disease. The combined average lethal rate of the pneumonias is close to twenty-five per cent. As a cause of invalidism and death, the pneumonias outrank the communicable diseases of childhood. They occupy third place in the mortality bills of New York City, New York State and the United States death registration area, preceded only by the diseases of the heart and by cancer. They take a very large toll among people of the most productive age groups. There are few prevalent acute conditions which have such a high mortality or are as expensive to treat.

Within the last decade the curative value of concentrated specific immune horse serum has been established for the pneumococcus pneumonias of Type I and Type II, and evidence is rapidly accumulating that it is also efficacious in Types V, VII, VIII and XIV. The general introduction of specific serum therapy has been slow. The possible reasons for it are:

* Report of the Committee on Public Health Relations of The New York Academy of Medicine by a special subcommittee: Russell L. Cecil, *Chairman;* Jesse G. M. Bullowa, Henry T. Chickering, E. H. L. Corwin, *Secretary.*

1. The lingering of the dictum that the disease is self-limited;
2. Hesitation on the part of general practitioners to employ serum intravenously;
3. The difficulty in obtaining serums and their high cost;
4. Lack of facilities for the differentiation of pneumococci;
5. Failure on the part of health authorities, except in New York, Massachusetts and several other communities, to recognize the communicable character of the pneumonias, and to urge appropriations for the free distribution of the antipneumococcus serums.

The Bureau of Laboratories of the New York City Health Department, the Rockefeller Institute and several of New York's hospitals, notably Bellevue and Harlem, have made very important contributions to the development of specific therapy for pneumonia.

II.

A Brief Historical Retrospect

It has been established that the etiologic factor of lobar pneumonia in man is the pneumococcus, although other micro-organisms are sometimes identified with true cases of lobar pneumonia. The following Table gives the bacterial flora in lobar pneumonia on the basis of 2,000 cases:*

	Cases	*Per Cent*
Pneumococcus	1913	95.65%
Streptococcus hemolyticus	76	3.8 %
Pneumobacillus Friedländer	8	0.4 %
Hemophilus influenzæ	1	0.05%
Staphylococcus aureus	2	0.1 %

It is impossible within the short space of this section to give a detailed history of the evolution of pneumonia serum therapy. Only the highlights will be touched upon.

To Weichselbaum is conceded the credit for having definitely established in 1886 the causal relation of the

* Cecil, Baldwin and Larsen, Archives of Internal Medicine, 40, p. 253, 1927.

pneumococcus to lobar pneumonia. The discovery by Neufeld of the solubility of pneumococci in bile led to the method of differentiation between the pneumococcus and the streptococcus. Pioneering work in the utilization of immune serum in pneumonia was done by the Klemperers in 1892, followed by Eyre and Washbourn, and by Elser and Roper at New York Hospital in 1909 and 1913.*

In 1909 Neufeld and Haendel first demonstrated the existence of antigenically different types of pneumococci. They also noted that the protective action of the anti-pneumococcus serum in mice was limited to the homologous strain of pneumococcus. In the two papers which they published in 1910 they discussed the need of type determination for effective serum therapeusis. They gave an account of the results obtained by them in treatment of patients with intravenous injections of potent antipneumococcus horse serum. They called attention to the need of administering large doses to obtain beneficial results.**

In this country it was under the auspices of the Medical Commission for the investigation of Acute Respiratory Diseases of the Department of Health of the City of New York that the earliest work on the pneumococcus began. This Commission was organized at the suggestion of Hermann M. Biggs in 1904 and a special grant of $10,000 for the work was made by the Board of Estimate and Apportionment. E. G. Janeway was the President, William Osler, Vice-President, and T. Mitchell Prudden, Secretary; the other members being William H. Welch, L. Emmett Holt, Frank Billings, John H. Musser, Theobald Smith and Francis P. Kinnicutt. The cooperation of a number of outstanding bacteriologists and pathologists was secured under the leadership of Biggs, William H. Park and Anna Williams. Reports were first published in the Journal of Experimental Medicine and Biology in 1905, and in the Journal of Infectious Diseases in 1906 and 1907.

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* Joseph C. Roper, "Serum Treatment of Pneumonia," Medical Record, Vol. 86, No. 5, pp. 187 and 224.

** "Weitere Untersuchungen m.d. Pneumokokken Heilsera" Arb. a.d.k. Gesundheitsamte, 1910, 34, pp. 293-304; 36, p. 166.

In Part I of the Report of the Commission, published in 1905, there appeared a paper by Katherine R. Collins, of the Bureau of Laboratories of the City Department of Health, in which the following conclusions were presented:

1. "Pneumococci, by reason of their agglutinating properties, exhibit a tendency to separate into numerous groups similar to streptococci."
2. "Pneumococcus mucosus forms a distinct and consistent variety. The production by it of common agglutinins for some pneumococci and the resistance of the agglutinins produced by it to absorption by the streptococcus indicate a nearer relation to the former than to the latter organism."

Further contributions to the biology of the pneumococci were made by Dochez and Gillespie of the Rockefeller Institute in 1913, and by Dochez and Avery in 1915. Their studies showed that there were at least three distinct and fixed types of pneumococci designated respectively as Type I, Type II and Type III, which comprised about 80 per cent of all the strains of pneumococci encountered in patients with lobar pneumonia. The pneumococci which were found in the other patients were for the most part unrelated to one another and were designated as Group IV.

This work led to extensive clinical studies with unconcentrated antipneumococcus Type I serum at the Rockefeller Institute by Cole and Dochez (1913), and later by Avery, Chickering, Cole and Dochez (1917). In 1920, Cecil and Blake showed that monkeys inoculated with a fatal dose of pneumococcus Type I could be protected with specific Type I horse serum.

As a result of the influenza pandemic of 1917 and 1918, the Metropolitan Life Insurance Company appointed a Commission known as the Influenza and Pneumonia Commission of the Metropolitan Life Insurance Company. This Commission held its first meeting on July 15, 1919. It consisted of Milton J. Rosenau, Chairman, William H. Park, G. W. McCoy, W. H. Frost, E. O. Jordan, Lee K. Frankel and Augustus S. Knight, Medical Director of the

Metropolitan Life Insurance Company. The Commission is still in existence, with the same Chairman, but with a changed membership. During the year 1920, the work of the Commission was limited to epidemiologic and immunologic studies of influenza. In the following year a series of studies on the prophylactic use of influenza vaccines was made and experiments carried on in New York and Massachusetts with pneumonia vaccines. At that time it was found that the extracts of the pneumococcus had no better prophylactic virtues than the vaccines usually made.

The refinements in the production of the pneumococcus immune serum were due to a number of workers. New York City was the pioneer in this field, the first really practical method for concentrating a specific immune serum, namely, diphtheria antitoxin, having been devised in the Bureau of Laboratories of the Health Department by Robert B. Gibson in 1905. Subsequently, various modifications and improvements were made by Banzhaf, also in the Bureau of Laboratories of the Department of Health.

In 1915, Gay and Chickering were the first to show that the immune bodies in pneumococcus serum could be separated by biologic methods. Further fundamental work along these lines was done by Huntoon. Though Huntoon's antibody solution possessed definite therapeutic value, it frequently caused severe and sometimes fatal reactions. It was used in the treatment of several hundred patients at Bellevue Hospital.

In 1924, working under Rosenau at Harvard University, Felton developed a concentrated antibody solution by precipitating the euglobulins with large quantities of distilled water. The production of Felton's serum was aided by a grant of $10,000 for three years, which was placed at the disposal of Dr. Park by Mr. Lucius N. Littauer, who, by subsequent grants, is said to have given the sum of $120,000 toward the study of pneumonia. The value of Felton's serum was conclusively demonstrated at Bellevue Hospital by Cecil and Sutliffe and by Cecil and Plummer; and at Harlem Hospital by Bullowa and Rosenbluth.

At this time, with the aid of another grant by Mr. Littauer, the first effective antipneumococcus Type II serum was produced at Otisville and refined by Felton. Its clinical value was demonstrated when it was used on the first, second or third day. Its efficacy in cases presenting bacteremia was proved by Baldwin at the New York Hospital.

In 1926, Georgia Cooper, and her co-workers at the Bureau of Laboratories of the Department of Health, began the publication of a series of studies on the different strains of pneumococci, which had been previously classified as Group IV, and succeeded in resolving them into 29 types. They obtained pure cultures and antiserums for each type. In the words of Rosenau, "This is considered one of the outstanding pieces of work of the Metropolitan Influenza and Pneumonia Commission." As a result of these studies the species of pneumococcus is now divisible into 32 types, each designated by Roman numerals.* Some of these types are more prevalent in adults; others in children.

In 1928, with the aid of funds given to New York University through Dr. Park, and in 1930, through funds given to Dr. Charles Hendee Smith by the Commonwealth Fund, and as the result of a study of pneumonias in children at Harlem Hospital through funds given Dr. Bullowa by the Littauer Fund, Types I, VI, XIV and XIX were recognized as the most common invaders of children. Further work in this field was financed by the Altman Foundation for the production and testing of serum for additional types that were associated with pneumonia in children.

In 1929, reports of the value of concentrated serum for the newer types began to be published. The clinical evaluation of the newly segregated types, V, VII and VIII, was largely the work of the Harlem Hospital workers, under the Littauer grant. This work was subsequently confirmed by the Boston City Hospital group.

* Some of the types are so closely related that the question has arisen whether they should be continued as separate entities; this applies particularly to Type XXVI, which is being classified with Type VI, and to Type XXX, which is now being classified with Type XV.

At that time an appeal was presented to the Commonwealth Fund by the Massachusetts Department of Public Health for a pneumonia study and service. The clinicians who experimented with the use of the serum in Boston were unanimous in believing that the serum should be distributed, the product made more potent, the cost lowered, and reliable data obtained on the dosage required if the benefits to be derived from the antipneumococcus serum were to be enjoyed by all those who stood in need of it. The Commonwealth Fund made the first grant in 1930, with the expectation that the demonstration would continue for five years. An advisory committee, under the chairmanship of Dr. George H. Bigelow, then Commissioner of Health of the State of Massachusetts, was organized, and Dr. Roderick Heffron became the executive who carried on the field work. The demonstration had a twofold objective, "the evaluation of pneumonia serum under the conditions of the general practice of medicine, and the development of plans for the distribution of this serum for the treatment of those patients who might reasonably be expected to benefit from its use."* It thus embraced problems of scientific research as well as of administrative procedure.

It is now recognized that the most effective use of serum depends upon the administration of the required amount in the shortest possible time. This is practicable only when the serum is of high titre. Felton's concentrated horse serum permits larger doses to be administered in smaller bulk and more effectively; it simplifies the procedure and reduces the incidence of primary reactions and of serum sickness.

Experiments are now being conducted by Goodner, Horsfall and McLeod at the Rockefeller Institute with unconcentrated but processed rabbit serum, and at Harlem Hospital under the direction of Bullowa with concentrated rabbit serum. Their limited experience to date indicates

* "The Commonwealth" Final Report of the Massachusetts Pneumonia Study and Service, 1931-1935, p. 4.

that rabbit immune serums have definite biologic advantages over horse immune serums.

III.

Development of the Rapid Method of Pneumococcus Type Determination

In view of the importance of early recognition of the type of pneumococcic infection for successful therapy, the development of the technique of rapid type determination from the sputum is an important milestone in the evolution of the specific treatment of pneumonias. The pioneer work in this field was done by Krumwiede and Noble of the Bureau of Laboratories of the New York City Department of Health, who in 1918 worked out a method whereby they were able to differentiate the types from the sputum within a comparatively short period of time; its reliability was not established. Later Sabin devised the stained slide agglutination technique which saved time and material. The original methods of typing required considerable quantities of mouse peritoneal exudate for the agglutination tests.

Although Neufeld had described in 1902 the specific capsule swelling reaction, occurring when the pneumococci are acted on by the homologous immune serum, he appears not to have recognized its applicability to typing until nearly thirty years later. In 1931, in a study with Etinger-Tulczynska* he described the reaction again, and in a footnote, stated that it was a convenient method for determining types of pneumococci. Credit for introducing the Neufeld swelling reaction for direct typing of sputum in Great Britain goes to Richard R. Armstrong of St. Bartholomew's Hospital, and to W. R. Logan and J. T. Smeall of the Royal Infirmary of Edinburgh, who reported it simultaneously in the British Medical Journal of January 30, 1932. It was introduced in this country in 1932 by Goodner at the Hospital of the Rockefeller Institute, and was first described here by Sabin early in 1933, after a

* Zeitsch. f. Hyg. u. Infektiouskrank., Vol. 112, fasc. 3, p. 492.

test of it in 100 cases at Bellevue Hospital (J.A.M.A., 100, p. 1584). In 1934, Beckler and MacLeod reported on the use of the method at the Bacteriological Laboratory of the Massachusetts Department of Public Health in 760 specimens of sputum over a period of 16 months (J. Clin. Inv. 13, p. 901). On September 3, 1934, at a meeting of the American Public Health Association in Pasadena, Cooper and Walter reported on the reliability of the Neufeld reaction as ascertained in the tests made at the Bureau of Laboratories of the Department of Health in New York City (Am. J. P. H., 25, p. 469). Bullowa estabished the accuracy of the Neufeld method by direct cultures from the lung and blood.

IV.

Pneumonia Prevalence in New York City

Although pneumonia has been a reportable disease in New York City for many years the Health Department figures fail by a considerable margin to reflect the true number of cases of pneumonia in the City. An approximation of the divergence can be obtained by a comparison of the 16,972 reported cases of pneumonia in the year 1933, with the 20,163 patients with pneumonia known to have been discharged from the hospitals in that year. This discrepancy becomes even wider when it is realized that not all of the hospitals in the City were included in the study, nor were institutions other than hospitals. The prevalence of the pneumonias can therefore be only approximated from the mortality rate. The total number of pneumonia deaths has been decreasing annually since 1931, except for a slight upswing in 1936. During the last six years the number of deaths from pneumonia in New York City varied between 6,400 and 9,200. The average for the last three years has been 6,500 deaths. Assuming a case fatality rate of 25 per cent, the average number of cases of pneumonia during the last few years has been 26,000 per annum. There are no statistics to indicate how many of these pneumonias were of pneu-

mococcus origin, but assuming that 95 per cent of the lobar pneumonias, and 75 per cent of the bronchopneumonias were of this etiology, the total pneumococcic infections numbered 22,000. When the very young and the very old are eliminated it is safe to say that about 10,000 patients would be benefited by specific serum therapy. This figure should be borne in mind when plans are laid for the supply of antipneumococcus serum for New York City.

V.

Type Incidence in Pneumococcic Pneumonias

Many epidemiologic studies have been made of the types of pneumococcus found in patients ill with pneumonia. Considerable variations in the percentage distribution of the prevalent types have been observed. The latest study available is that of Bullowa and Wilcox, published in the March 1937 issue of Archives of Internal Medicine, which analyzes the distribution of the pneumococcus types and their variations in incidence and mortality for adults and children, on the basis of 3,371 cases treated at Harlem Hospital from July 1, 1928, to June 30, 1936. This study shows that among adults there are considerable variations in the several types of pneumonia from year to year; that Type I is consistently the most prevalent, followed by Types III and VIII, although in the year 1934-1935, Type V was next in prevalence to Type I, and in 1935-1936, Type VII took that place. The conclusion drawn from this study is that the endemic pneumonias are a series of diseases which vary in occurrence from year to year and from month to month, and that further studies of this character are needed to determine whether the specific types of pneumonia have individual cycles. The study also shows that there is a marked difference in the types of pneumonia found in children and adults living in the same community.

The variation in the prevalence of the pneumococcus types from year to year makes it difficult for the Bureau of Laboratories always to have adequate amounts of the dif-

ferent immune serums available to meet changing conditions.

VI.

Organization of Pneumonia Control in Massachusetts and New York State

The modern practical application of the antipneumococcus serum had its birth in New York City. As far back as 1911, the Research Laboratory of the Department of Health began the production and limited distribution of a polyvalent antipneumococcus serum made from strains prevalent at that time.

Four years later the Division of Laboratories and Research of the New York State Department of Health prepared Type I specific antipneumococcus serum for general distribution, and in 1917 sputum typing was added to the list of procedures required for qualification of approved public health laboratories rendering such service.*

In 1917 the Massachusetts Department of Health likewise undertook the production and distribution of pneumonia serum. The difficulties associated with the administration of unconcentrated serum and the frequency of severe serum reactions were responsible for the slow adoption of this mode of therapy. The intensive five-year pneumonia study and demonstration carried on in Massachusetts from 1931 to the end of 1935, with the financial aid of the Commonwealth Fund, paved the way for an effective plan of administrative organization.

In the fall of 1935, the New York State Department of Health undertook to organize a comprehensive pneumonia control program embracing not only the production and distribution of concentrated antipneumococcus serum, and the expansion of available laboratory facilities, but also active participation in graduate professional information, in lay education, in the expansion of public health nursing service to pneumonia patients, and in research on the epi-

* Edward S. Rogers, "Control of Pneumococcus Pneumonia," American Journal of Public Health, February 1937, p. 133.

demiology of pneumonia and the evolution of more adequate means for its control. This program was undertaken with the close cooperation of the State Medical Society and the New York State Association of Public Health Laboratories, with financial aid from the Metropolitan Life Insurance Company and the Commonwealth Fund.

In Massachusetts the serum for Type I and Type II pneumonia is being produced for general distribution through a system of so-called laboratory supply stations. There are 72 such stations scattered throughout the State. Thus far, only concentrated serums Type I and Type II are available to all physicians in the State. No charge is made for serum, regardless of the financial condition of the patient. Preparations are being made for distribution also of the therapeutic serums for infections of Types V, VII and VIII. This likewise is to be furnished without charge. In the distribution centers the Neufeld method of typing is used almost exclusively. In a few instances the Sabin or slide agglutination method is employed, either alone or in conjunction with the Neufeld method.

In order to conserve the available serum and to make it go as far as possible, two restrictions are being observed. No serum is given until the laboratory report indicates that the patient for whom it is requested is suffering from Type I or Type II infection, and then only for patients who have been ill for not more than four days. Physicians are requested to sign cards to this effect. Physicians who have received serums are expected to furnish the Department of Health with information concerning the patient after determination of the case. According to official report the two restrictions mentioned have encountered little criticism, although it would seem that it is very difficult to determine precisely the duration of the pneumonia from its onset to the time when the typing is done. The Massachusetts authorities are of the opinion that this time restriction aids in emphasizing the necessity of early typing and early treatment, which is so important in pneumonia. They admit that there are patients who, after the fourth day of illness, might be benefited by the administration of serum:

they are, however, prevented from changing the rule because of economic considerations. The distributing centers are authorized to issue serum in amounts of 60,000 units for Type I and 100,000 units for Type II. An additional 60,000 units for either type is permissible for the following three categories of patients:

a. Maternity patients.
b. Patients having a positive blood culture with Type I or Type II pneumococci in their blood, and
c. Patients whose temperature does not fall to 101° F. or under within eighteen hours, or in whom the temperature, after having fallen, has again risen to, or above, 101° F. in forty-eight hours.

In individual instances more than 60,000 units is given for the treatment of patients with persistent bacteremia, or to pregnant women.

Arrangements are under way to allot larger amounts of serum for older patients as it has been demonstrated that persons past middle age do not gain as much benefit from an average amount of serum as do younger persons.

In New York State the regulations differ somewhat from those of Massachusetts. Up to the beginning of this year only concentrated Type I antipneumococcus serum was distributed. During the year 1936, approximately 5,700 vials of 20 c.c. each of concentrated Type I were distributed. The 20 c.c. vials of Type I contain 25,000 therapeutic units. Type II is put up in 24 c.c. vials, containing 20,000 units, and its distribution began only on December 30, 1936.

The serums are distributed through laboratory supply stations. There are 106 of these for the distribution of Type I serum and 34 for Type II serum. The number of the latter will be increased as the need is demonstrated and the supply of serum becomes sufficient to meet increased demands.

In New York State, as in Massachusetts, the serums are given away entirely free to all classes of patients, but there is no restriction as to time limit for its administra-

tion. It is left entirely to the physician's discretion. He is, however, requested to fill out a form, giving certain fundamental data in order to obtain the serum. In New York State the minimum dosage recommended is considerably higher than that in Massachusetts—100,000 units for Type I cases and 160,000 for Type II cases.

VII.

Serum Production in New York City

The New York City Health Department Bureau of Laboratories has been producing and distributing antipneumococcus serum for eleven of the more prevalent types. The Table here produced gives the statistics of production of the various types during the years 1935 and 1936, in terms of vials.

PRODUCTION

Number of Vials of Antipneumococcic Serum Distributed for Therapeutic Use During 1935 and 1936

Types of Serums	1935 Uncon-cent. (1)	Concent. (2)	Total	1936 Uncon. (1)	Concen. (2)	Total
I & II (Bivalent)	3,646	1,191	4,837	2,548 (3)	1,416 (3)	3,964
II & V (Bivalent)	170 (3)	339	509		236 (3)	236
III & VIII (Bivalent)		413	413		25 (3)	25
I	1,292	466	1,758	1,613 (3)	615 (3)	2,228
II		273 (3)	273		1,501	1,501
IV		352	352		174 (3)	174
V	380	385	765	333 (3)	682	1,015
VI		253	253		88	88
VII	567	390 (3)	957	794 (3)	110 (3)	904
VIII	706	366	1,072	1,234	778	2,012
IX		145	145		165	165
XIV	234	307	541	502 (3)	72 (3)	574
XVIII		123	123		328	328
XIX		39 (3)	39		91 (3)	91
Total	6,993	5,042	12,037	7,024	6,281	13,305

(1) Vials containing 25 c.c. unconcentrated antiserum—potency 800 to 3,000 units per c.c.—average 1,000 units per c.c.

(2) Vials containing 10 c.c. concentrated antiserum—potency 800 to 8,000 units per c.c.—average 2,000 units per c.c.

(3) Available only during part of period.

The production of effective serums for the different types of pneumonia is not a simple matter. Horses must be immunized over an average period of almost fifteen months to develop antibody content of sufficient potency; some horses respond better than others. During the past few years the Bureau of Laboratories has maintained at Otisville an average of about forty horses for antipneumococcus serum. Part of the work involved in the process of concentration of the serum is done in New York City.

During the past year the Bureau of Laboratories of the Health Department produced $85,000 worth of antipneumococcus serum. It is estimated that each horse produces about $2,000 worth of serum per year. These figures are based on the actual cost of production and are the same as those of the Massachusetts State Health Department Laboratory, namely, $.35 per 1,000 units of concentrated serum, Type I and Type II. The cost varies somewhat with the type and whether the serum is monovalent or bivalent. For practical purposes, $.35 per 1,000 units is a basic figure. Assuming the average therapeutic dose to consist of 100,000 units, the average cost of serum per patient is $35.

In planning for the future the Department of Health in this City must determine the extent to which the City is ready to make available this life-saving remedy to all those in the population who are unfortunate enough to develop the disease, and who are unable to purchase the serum from commercial laboratories.

It is the opinion of this Committee that in view of the communicable character of the pneumococcic infections and their mode of spread through congestion in places of work, in public conveyances, schools, etc., the city should provide this serum on the same basis as it provides all other biological products — serums, antitoxin, toxoids and vaccines.

The cost of community provision of antipneumococcus serum can readily be established if the demand is forecast. In Part IV of this Report it has been estimated that on the

average, 10,000 persons in New York City may be in need of serum during the year. In view of the slowness with which this specific serum therapy has been adopted, it is unlikely that a maximum demand will develop during the next year. It is more likely that the demand may not exceed the requirements of 5,000 persons. On the basis of $35 as the average cost, the expenditure for serum which the City would have to incur would be $175,000. It is possible that the demand in the future may exceed this estimate. In the opinion of this Committee it is advisable for the City to plan for the increased production of the serum rather than depend on the supply from commercial laboratories. In view of the experiments with rabbit serum it is possible that in the future, most, if not all of the antipneumococcus serum may be produced in rabbits. This may decrease the cost.

VIII.

Facilities for Clinical Consultation and for Typing

The successful administration of serum is a highly technical procedure requiring expert knowledge. Advice is often asked of the Bureau of Laboratories concerning technical procedures and no one with the necessary clinical experience and time is as yet available to render the required service. It is the opinion of the Committee that a consulting service should be established, similar to that provided by the Laboratory in connection with meningitis and other communicable diseases of the central nervous system. It should be headed by a physician well trained in the knowledge and technique of serum therapy. A physician of this character should command a salary commensurate with the chiefs of other clinical services in the Department of Health. In addition, the Health Department should make arrangements with a number of men located in various districts of the City who are well known for their competence in this field, and who would be willing to respond to calls for consultation service at moderate fees which the City would be able to pay. It has been estimated that for a time at least about ten such men would be

required to answer the emergency calls. The cost of such a consulting service, exclusive of the salary of the Supervisor, would probably not exceed $10,000.

As has already been stated, the effectiveness of serum therapy depends on its early administration. Facilities should be provided for quick diagnostic laboratory service. It is suggested that at least one laboratory be established in every borough for type determination, these laboratories to be centrally located and available daily to all physicians from ten to six o'clock or later. In view of the fact that such diagnostic laboratory work is sometimes needed during the night it is recommended that one of the laboratories be maintained throughout the night. Each laboratory would require two technicians. The Committee therefore recommends that provision be made for fourteen technicians (two for each of the six typing stations and two to act as substitutes). The average salary of a technician is about $1,000 a year. This would add to the budget about $14,000 annually. Not all of this sum should be charged to pneumonia because during the months when pneumonia is not prevalent these technicians would be assigned to other work in the Bureau of Laboratories, which is understaffed.

IX.

The Pneumonias as a Public Health Problem

Early recognition and early serum treatment are needed to check the spread of the pneumonias. Treatment of the pneumonias requires the same aseptic technique that applies to other communicable diseases. The incidence and mortality of communicable diseases has been lowered by segregation in special hospitals. It is therefore recommended that the pneumonia patients treated in hospitals be properly segregated and cubicled.

In view of the emergency character of the pneumonias, the hospitals should consider pneumonia patients in the same category with acute surgical cases, both from the standpoint of immediate preferential admission and of emergency service, night or day, by responsible members of the clinical and the laboratory staffs.

X.

Recommendations

1. During the next few years the City Department of health should engage in a vigorous campaign against pneumonia. It should establish a Division of Pneumonia Service in the Bureau of Laboratories, headed by a properly qualified physician.

2. Through the regular medical channels physicians should be made cognizant of the fact that serum is life-saving in certain types of pneumonia and that the particular type of pneumococcic infection from which the patient may be suffering should be determined at the earliest possible moment. Facilities for the rapid determination of the type of infection should be made available at public expense at conveniently located points throughout the City. At least one such center should be maintained in each borough from ten in the morning until late in the evening, and at least one laboratory should be available for type identification during the night.

3. Because of the communicable nature of the pneumonias it is highly desirable that pneumonia patients in hospitals be segregated in cubicles, and that a complete aseptic technique be followed.

4. Pneumonia patients should be considered in the same urgent category with emergency surgical cases. Certain physicians on the attending staff should be made responsible for the treatment of these patients and should be on call day and night, as is the custom on the surgical services.

5. In connection with the Division of Pneumonia Service of the Department of Health, a clinical consultation service similar to that rendered by the Meningitis Division should be established to aid physicians in the administration of serum therapy, and in the taking of specimens of blood and sputum for bacteriological study.

6. In all instances of death from pneumonia, physicians should be requested to report the precise nature of the invading organism.

7. Concentrated serum for the prevailing types of pneumonia should be made available without cost to physicians requesting it, provided the type of pneumonia has been ascertained prior to the request for serum.

8. The control work of pneumonia and the production of therapeutic serums should in no way be allowed to interfere with the fundamental research activities of the Bureau of Laboratories of the Department of Health.

9. Adequate funds should be provided to the Department of Health for pneumonia control work and to further the necessary research. The minimum budget required for the year 1938 is estimated at $225,000, of which $85,000 is for the continuance of production of serums on the present scale, $100,000 for the purchase of additional serums pending the development of production facilities at Otisville Farm, and $40,000 for the salary of the chief of pneumonia control, the payment of consultants' fees, for equipping diagnostic type determination centers, for the maintenance of technicians at these laboratories, and other incidental expenses.

10. It is estimated that a capital outlay of about $200,000 may be required for the construction of new stables at Otisville to house additional horses; for the required extensions to the Laboratory; for the residence of the additional personnel required; and to meet other expenses incidental to the increase in the production of the serums. Should the use of rabbit serum prove efficacious, the cost of the construction for housing the animals would be much lower than estimated. It is recommended, however, that the entire sum be appropriated so that the Department of Health may be in a position to meet emergencies during the next year promptly.

11. It is recommended that the serum produced as a result of the recent State appropriation of $400,000 under the Hawkins-Schwartzwald Act be made available to all parts of the State, including the City of New York, in proportion to their relative requirements, as a supplement to the pneumonia control work of local communities.

July 1, 1937